

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Amendment of Part 15 of the Commission's	)	ET Docket No. 14-165
Rules for Unlicensed Operations in the	)	
Television Bands, Repurposed 600 MHz Band,	)	
600 MHz Guard Bands and Duplex Gap, and	)	
Channel 37, and	)	
	)	
Amendment of Part 74 of the Commission's	)	
Rules for Low Power Auxiliary Stations in the	)	
Repurposed 600 MHz Band and 600 MHz	)	
Duplex Gap	)	
	)	GN Docket No. 14-166
Promoting Spectrum Access for Wireless	)	
Microphone Operations	)	
	)	GN Docket No. 12-268
Expanding the Economic and Innovation	)	
Opportunities of Spectrum Through Incentive	)	
Auctions	)	

**COMMENTS OF SINCLAIR BROADCAST GROUP**

Interference prevention is the *raison d'être* of the FCC. Commerce Secretary Herbert Hoover's premise in advocating the creation of the 1927 Radio Act was to prevent "chaos of the airwaves" when multiple users attempted to access a particular frequency simultaneously. Although we have come a long way in the ensuing 88 years with multiple new services and technological innovations, the essential FCC mission in regulating spectrum use remains: prevent interference. The laws of physics have not changed and repacking broadcasters in bands reserved for mobile wireless broadband highlights the Commission's challenge.

In this regard, the Commission should take notice of the attached article by Charles Rhodes and the Technology Fact Sheet produced by the European Broadcasting Union. Using the Commission's recently adopted ISIX model, Mr. Rhodes cautions that harmful interference will indeed occur and be far greater with the aggregation of "Super Blocks" (10 MHz wide assignments) by wireless carriers. ISIX interference can arise from signals offset in frequency by more than 6 MHz. In fact, Mr. Rhodes notes that two Super Blocks of 10 MHz each may generate third-order distortion products spanning a significant 27 MHz. In short, broadcast and wireless broadband will demonstrably interfere with each other and that will be exacerbated by placing broadcast channels in close proximity to wireless users in the Duplex Gap.

The study of the European Broadcasting Union study which investigated potential sharing of wireless LTE and broadcast spectrum similarly concludes that such sharing is impractical; LTE cannot share spectrum with digital broadcasting. These cautionary predictions should inform the

Commission as it seeks to repack broadcast channels in the Duplex Gap. Neither broadcasters nor wireless broadband users will find the sharing acceptable.

Respectfully submitted,

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/s/  
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September 22, 2015

## **Attachment**

# Assessing Post-Repack Channel Options

September 11, 2015



By [Charles W. Rhodes](#)

It's a given that there is going to be considerable "channel shuffling" after the upcoming television broadcast spectrum auctions. There also will be a lot less in the way of channel slots to choose from in the subsequent station repacking action. In 2014, the FCC adopted methodology for predicting interference between TV broadcasters and broadband wireless transmitters that are operating either in co-channel or adjacent-channel frequency slots. The commission termed their interference-prediction methodology, which is based on the Longley-Rice propagation model, "ISIX."

Looking at some cases where ISIX interference cases may come into play, suppose your station were to be allocated Channel 28 (center frequency = 557 MHz) in Scenario 7 (see Fig. 1). Your general manager might ask you to become a fortune teller and tell him whether this is a robust channel or a not so robust.

An ISIX interference situation may result if there two strong signals whose center frequencies are F1 and F2 and your center frequency is below F1 by the difference in frequencies F2–F1. IM3 falls in Channels N and N+3, if there are strong undesired signals on Channel N+K and N+2K. (K is an integer, either positive or negative). For example, if there is a signal on Block A 619.5 MHz, (N+K) and a second signal is centered at 682 MHz, (N+2K) then F2–F1 = 62.5 MHz. Subtracting 62.5 MHz from F1 = 557 MHz, the center of your channel.

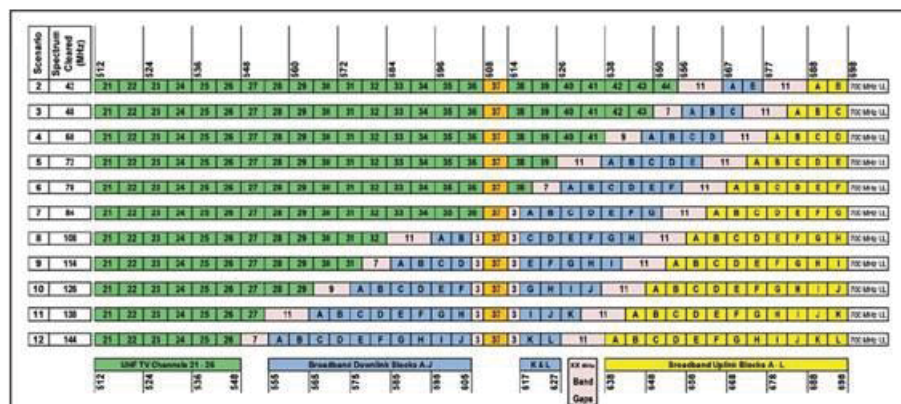


Fig. 1: Derived from Fig. 23, page 453 of FCC document 14-50 dated May 15, 2014 by Stanley Knight  
[Click to Enlarge](#)

In this example F1 is in the blue area, meaning F1 is being radiated by a base station. F2 is in the yellow area, meaning this signal is being radiated by a cellphone.

## **INTERFERENCE CAUSES NOT ALWAYS APPARENT**

Base stations radiate most of the time and their effective radiated power (ERP) approaches 1,000W. Cellphones briefly transmit and their ERP is less than 23 milliwatts. ISIX interference may result only when both F1 and F2 are transmitting simultaneously. Moreover, in this example F2 will be strong only if the cellphone is extremely close to the DTV receiving antenna. If either F1 or F2 is not strong, there can be no ISIX. However there are many base stations serving a given community, and many base stations will be found near interstate and other major highways. Many viewers rely on an indoor antenna so your received signal power from these indoor antennas may be quite weak even when the receiver is not near your noise-limited coverage perimeter. Base stations are generally only a few miles apart.

Therefore ISIX may be found around base stations.

While the first 600 MHz auction will auction 5 MHz blocks, after that most successful bidders will have acquired two or more blocks of 600 MHz spectrum. I expect that many of them will bid for contiguous blocks of 600 MHz spectrum so that they wind up with 10 MHz “super blocks,” which will be far more profitable than individual 5 MHz Blocks.

Fig. 1 shows that the spectrum for uplinks and down-links are equal for a given scenario. For Scenario 7, there are seven 5 MHz blocks for uplinks (cellphone Tx) and seven more for down-links (base station Tx).

This would allow up to three 10 MHz super blocks plus one 5 MHz block; or two super blocks and three 5 MHz blocks; or one super block and five 5 MHz blocks. For example, there could be three super blocks: A\*B, C\*D, E\*F and one 5 MHz block, G. Or there could be super blocks B\*C, D\*E and F\*G with one 5 MHz block A. There are many other combinations of 5 MHz blocks and super blocks 10 MHz wide. The LTE signal bandwidth is 4.5 MHz for a 5 MHz block, and it will be 9 MHz for a super block of 10 MHz width. This means that the effective radiated power of a super block of 10 MHz is 3 dB greater than for a 5 MHz block. There is another subtle difference between the 5 MHz blocks to be auctioned initially, and 10 MHz super blocks. ISIX interference generated in a receiver is spread over  $3 \times 4.5 = 13.5$  MHz. A 10 MHz super block will generate ISIX interference spread out over 27 MHz.

So the problem of ISIX interference to the reception of an ATSC signal will be far greater with super blocks (10 MHz wide) than with 5 MHz blocks for these reasons. However the FCC does not consider ISIX except for co-channel interference (CCI) or

adjacent channel interference (ACI). Broadcasters should be concerned with the fact that ISIX interference can arise from signals offset in frequency by more than 6 MHz because the FCC will not consider offsets between DTV signals and LTE signals greater than 6 MHz. Two super blocks of 10 MHz each may generate third-order distortion products spanning 27 MHz! This is well known, but not recognized by the FCC as causing “harmful interference.” Where it happens the affected receive cannot look to the Commission or broadband operators for relief. This was pointed out in my June column “FCC ‘Harmful Interference’ Definition Gives Wireless a Pass” on [www.tvtechnology.com](http://www.tvtechnology.com).

### **ANOTHER INTERFERENCE EXAMPLE**

Looking again at Fig. 1, you will note that the frequencies of LTE signals for a given block vary with the scenario number. Therefore you will need to know what blocks will be radiating LTE signals in your community. Whether the FCC will identify the scenario it applies for your market and your new channel number or just your channel number remains to be seen.

We will start with super block D\*F whose center frequency is 639 MHz.  $F2 = 639$  MHz.  $F1$  is equally distant between Channel 28 and the center of super block E\*F. So  $F1 = 0.5(639 - 557) = 598$  MHz. This is in the green portion of the 600 MHz band, which for Scenario 7 is a TV channel (Channel 35). So here we have a hybrid of undesired signals, one LTE signal on super block E\*F and DTV signal on Channel 35. Channel 35 will not cause CCI or ACI to Channel 28, so it is quite probable that there may be both Channels 28 and 35 in the repacking scheme for your community. But, there also may be ISIX to your Channel 28 signal from this combination of super block E\*F and Channel 35 signals, however the FCC does not recognize such interference as being harmful interference.

With these facts, you will be able to answer questions about how your station will fare after repacking.

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# CAN LTE SHARE SPECTRUM WITH DTT?

Mobile vendors predict an unstoppable rise in Mobile data consumption, and have already obtained mobile allocations in the 700 MHz and 800 MHz bands. Administrations are now being asked to consider a further allocation in the remaining part of the UHF band, below 694 MHz, which is used in most countries for DTT. Some Mobile proponents claim that they can share the band with broadcasting. However, technical studies carried out in ITU-R - and confirmed by recent real cases - do not support this claim.

## BACKGROUND

In 2007 and 2012, the ITU made two allocations to the mobile service in parts of the UHF band used by DTT: the 800 MHz band (790-862 MHz) and the 700 MHz band (694-790 MHz). Both allocations have resulted in the need to clear broadcasting and other services from these bands. The allocations, including the required guard bands and duplex gaps, have reduced the amount of UHF spectrum available for DTT by 43% (21 channels of 8 MHz each taken out of 49 channels initially available for broadcasting).

Agenda item 1.1 at the 2015 World Radiocommunications Conference deals with the allocation of further spectrum for the mobile service, with identification for use by International Mobile Telecommunication (IMT) applications. In preparation for this agenda item, in February 2012, the Joint Task Group (JTG4-5-6-7) of ITU was given the task of studying the technical conditions of sharing the UHF band between IMT and Digital Terrestrial Television (DTT). The aim was to assess the possibility of allocating the remaining part of the UHF band, i.e. 470-694 MHz, to the mobile service on a co-primary basis with the broadcasting service.

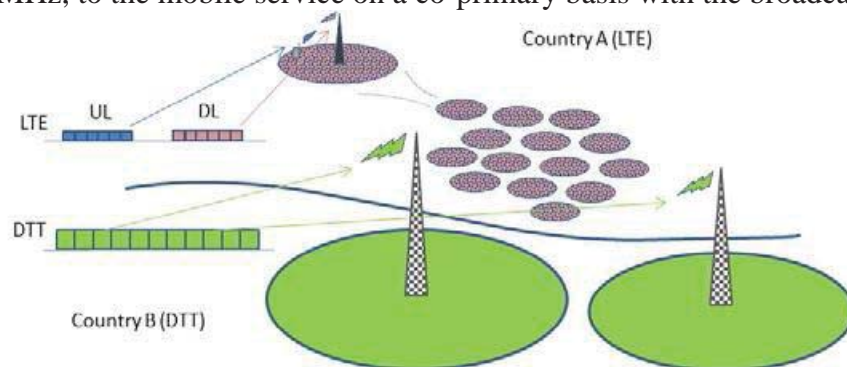


Figure 1. Illustration of the main differences between DTT and LTE features relevant for sharing studies



The mobile system considered in these studies was the Long Term Evolution (LTE) mobile system (part of the IMT family, standardized in 3GPP1), which uses similar characteristics to those systems implemented in the 800 MHz band and foreseen in the 700 MHz band. In particular, these mobile systems use a cellular network structure with a density of base stations that is considerably higher than the density of broadcasting transmitters. They require frequencies for both their downlink (DL) and uplink (UL). These frequencies can either be separate (as shown in Figure 1), referred to as Frequency Division Duplex (FDD), or identical and time shared, referred to as Time Division Duplex (TDD). The bandwidth of a downlink or uplink block is different from the bandwidth of a DTT signal. Each downlink or uplink block is used through large areas that cover entire countries or regions. These features are illustrated in Figure 1.

Technical sharing studies were carried out between February 2012 and July 2014. They covered co-channel and adjacent channel cases and considered protection of DTT from LTE and vice versa.

The results of these studies related to the 470-694 MHz band are included, with detailed assumptions and methodologies, in Report ITU-R BT.2337, published in November 2014. These results are summarized in the following section.

## WHAT DO THE STUDIES CONCLUDE?

From an international perspective, the main issue about sharing a given frequency band by two different services is that two neighbouring countries may wish to use the same frequencies on either side of the border for different services. An example could be the use of the band for DTT in Spain while using the same band for LTE in Portugal.

This corresponds to co-channel operation, for which each system needs to operate in presence of interfering signals from the other system. Ideally, this needs to be made possible in the entire territory of each country, but practically a separation distance will be required. The difficulty of sharing is therefore evaluated by assessing the required separation distance from the border beyond which no coordination is needed between the two administrations.

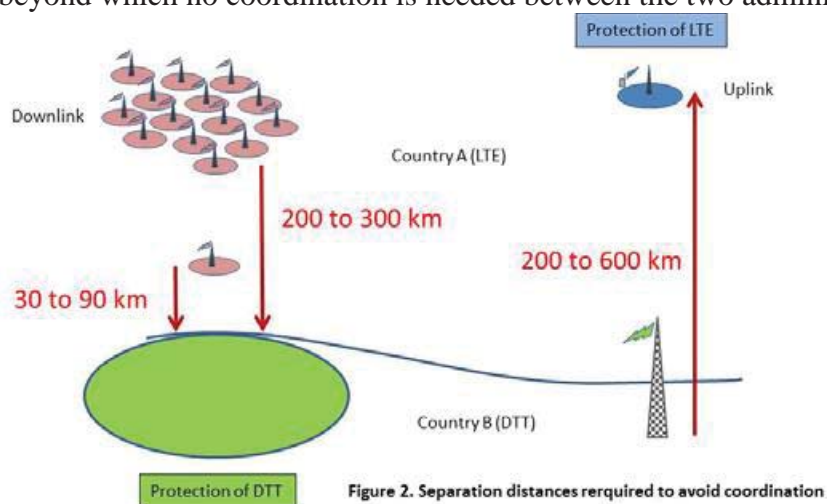




Figure 2 summarizes the main results of the studies. Concerning the protection of DTT from LTE base stations (downlink), the required separation distance to avoid coordination of a single LTE base station over a land path is between 30 and 90 km, depending on the characteristics of the base station. Over a warm sea path, the required separation distance may increase up to 700 km. Furthermore, a major issue raised by several studies is the possible accumulation of interference due to the use of the same frequency by a large number of base stations. In other words, while a single LTE base station could be implemented without coordination and without causing cross-border interference to DTT, the geographical extension of the LTE network using the same frequency may end up by causing interference to DTT in the neighbouring country. In order to avoid such a situation, the studies indicate that a separation distance over a land path between 200 and 300 km would in fact be needed. And over a warm sea path, the separation required is more than 1000 km.

Concerning the protection of LTE base stations (uplink) from DTT, the required separation distance over a land path calculated by the studies is of the order of several hundreds of kilometres, between 200 and 600 km, depending on the emission characteristics of the DTT transmitters. This large required separation is explained by the fact that the receiving antenna of the LTE base station is located at 20-50 m height above ground level and the receiver is very sensitive, while DTT transmitters are usually located at high altitudes above sea level (hundreds or even thousands of meters) with large antenna heights above ground level (a few hundred meters). They can also radiate high powers (50 kW or 200 kW e.r.p. in some cases).

This critical aspect of the protection of LTE uplink from DTT has been confirmed in a real situation between Spain and Portugal in the 800 MHz band<sup>2</sup>. This is also expected to be a major difficulty in the implementation of IMT in the 700 MHz band during the transition period, unless a coordinated approach between administrations is defined for the release of the band by broadcasting. At the European level the date of 2020 (+/- 2 years) has been proposed for this release<sup>3</sup>.

Therefore, with the current characteristics of the LTE system, the answer to the question “Can LTE share spectrum with DTT?” would be “NO”. However, some mobile systems other than LTE are currently and effectively sharing spectrum with DTT; this is the case of Programme Making and Special Events (PMSE) applications which successfully uses the gaps between DTT channels in a given area, called TV white spaces. Various other mobile systems exploiting the TV white spaces on a secondary basis (no interference to and no protection from the primary broadcasting service) are currently being tested in the UHF band in some countries. An adequate design of a future IMT system which takes into account the required protection of DTT, and doesn’t impose restrictions on DTT for its own protection, might change the answer to the above question.

## **WHAT IS THE EBU DOING?**

EBU, with experts from its member organizations, carries out technical studies and contributes to working groups of National, Regional and International organizations (CEPT, EU and ITU). EBU also develops technical notes and reports intended to inform its member organizations about specific issues related to sharing. In addition, EBU coordinates, represents and promotes

the views of its member organizations in regional and international forums, in particular in WRCs.

### **FIND OUT MORE**

EBU SDB (Sharing with Digital Broadcasting) group [tech.ebu.ch/groups/sdb](http://tech.ebu.ch/groups/sdb)

EBU SMR (Spectrum Management and Regulation) strategic programme  
[tech.ebu.ch/groups/sm](http://tech.ebu.ch/groups/sm)

ITU-R Report BT.2337 and other reports <http://www.itu.int/pub/R-REP-BT/en>

### **DATE**

August 2015

1 See TS 36.101 v12.9 and 36.104 v12.9

2 See Reports ITU-R BT.2301-1 and ITU-R BT.2247-3.

3 See the Lamy report on the future use of the UHF band, including proposed dates for the release of the 700 MHz band